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14. ABSTRACT

The stand alone level-1 Ryder Trauma Center in Miami, Florida sees over 3,000 admissions of seriously injured patients on an annual basis. The Ryder Trauma Center is a vertical representation of the battlefield. This living laboratory parallels the same process as the military battlefield. Dr. Augenstein has been a leader in the areas of development, research and implementation for trauma informatics for over well over 25 years. Recently technology has begun to catch up with the needs of busy clinicians. Portable devices like Pocket PC's or IPOD's have surfaced as usable tools in the medical arena. Although these new tools are being used in the medical field to further research, testing still needs to continue in order to meet the demand required in complex environments.

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Introduction

The Field Test of the Battlefield Medical Information System-Telemedicine (BMIS-T) grant was originally awarded to Dr. Thomas Knuth, the first commander of the United States Department of Defense Army Trauma Training Center (ATTC) at the Ryder Trauma Center (RTC). The Ryder Trauma Center is a level-1 Trauma Center located on the University of Miami/Jackson Memorial Hospital Campus in Miami, Florida. At the time of funding Dr. Knuth believed that members of the Forward Surgical Teams (FST) being trained at the ATTC would utilize the BMIS-T software for documentation of patients admitted to the resuscitation unit at Ryder Trauma Center. The William Lehman Injury Research Center (WLIRC) and the Medical Computer Systems (MCSL) Laboratory at the University of Miami Miller School of Medicine, have focused on the use of informatics and education in a complicated clinical setting for many years.   WLIRC/MCSL University of Miami is a subcontractor to Jackson Memorial Hospital who was the recipient of this contract.

Two significant problems arose from this initial proposal:
1. BMIS-T software was not complete enough to allow for the creation of the full documentation required for the description of the resuscitation phase of trauma care.
2. The BMIS-T application design was directed to medics in the battlefield

As the curriculum for the FTS'sevolved, it became clear that the teams had to take full responsibility for the work-up and management of patients admitted into Ryder Trauma Center. This was necessary to ensure that Forward Surgical Teams received effective training on the care of a trauma patient. In order for this to be accomplished and for the patient to receive optimal care, it was necessary for all documentation to be performed on Ryder Trauma Centers information system called C.A.R.E.. This system is a highly evolved application that meets the demands of trauma care providers in a very busy resusitation unit.

The C.A.R.E. system creates detailed physician and nurse documentation and generates data for billing, administrative and research purposes. Nearly 70% of the data elements entered into the trauma registry are captured through the C.A.R.E. documentation processes at the point-of-care.

After it was determined that BMIS-T would not meet the documentation demands required in resuscitation, efforts began to develop a system that integrated the mobility of the BMIS-T system with the documentation flexibility offered by the C.A.R.E. system. This required BMIS-T to reach a level of application development and software architecture so that members of the Ryder Trauma Center information systems development team could integrate the application. Availability of software at that level occurred in May 2005. Since that time, Ryder personnel have been studying the BMIS-T application for integration purposes.

Additionally, the BMIS-T research program was placed in the context of other federally funded research evaluating trauma training, team training, computerized education, documentation and point-of-care reminder systems. This was done to expand the possibilities needed to develop an all inclusive system.

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Body

There are six components to the BMIS-T research program at the Ryder Trauma Center. These include:
1. Definition of in-hospital documentation requirements for the resuscitation phase of trauma care
2. Definition of an ideal handheld application for trauma care
3. Evaluation of the BMIS-T software to determine if the various requirements can be met.
4. Development of handheld software connectivity to the C.A.R.E. system
5. Evaluation of BMIS-T component applications in a simulated clinical environment
6. Evaluation of component applications in a real-world clinical environments

An in depth evaluation was performed to determine the ideal application set to function on a handheld computer system. It was determined that the following components were necessary:

- An injury description module to characterize the evolving understanding of a patient's anatomic and physiological aspects of injury.
    o The interventions and responses to interventions must also be able to be documented. The system must connect to the diagnostic and procedure coding required for hospital professional billing.
- A note writing application capable of describing the evaluation and plan of care as well as documenting commonly performed procedures.
- An order writing application to describe the specific elements in the plan of attack addressing the patient's injuries.
    o This must include the appropriate level of justification where necessary to support payment for services. Additionally, order sets must be able to be provided to respond to protocols.
- A reference and reminder component that allows the user to actively review materials (i.e. drug doses or treatment protocols).
    o This application should provide point-of-care reminders during various documentation tasks such as injury descriptions, not writing, and order writing.
- Video lectures covering the spectrum of initial trauma care.
    o These must be designed so that the user can experience parts of a lecture during available free time and return to the lecture at the point of departure. The lecture parts would be small enough so that short interval exposures that allow for viewing with the occasional free time that is available to trauma care clinicians. These components also could be referenced as part of the point-of-care reminder component of the overall system.

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o Additionally, these lectures should be segmented such that the user can quickly review a component of a learning module at the time of decision making. An example of this would be replaying the technique for inserting a central venous catheter before performing the procedure.

Initial evaluation of the current BMIS-T application identified the following gaps in what is needed for an all inclusive application and the current BMIS-T application:

- The BMIS-T application does not provide a platform for the delivery of video-based education.
- The injury description capabilities should allow the further defined anatomic disruption to be characterized at the time it is fully identified.
  o The application does allow for rudimentary injury description without the characterization of physiological consequences or the ability to provide an evolving description. For example, initially a patient may present with deformity and swelling of the right thigh. That would be documented in the initial survey. The first x-ray demonstrates that the deformity is a fracture at the mid thigh. Later the patient may develop a compartment syndrome in the thigh from swelling associated with vascular injury. They should be able to be documented at the time it is identified. The BMIS-T system does not allow that level of injury characterization.
- Dictation and free-form drawing are not available in BMIS-T.
  o Note writing is provided in BMIS-T through menu generated phrases. Additionally, free text entry documentation is available. It is clear from initial work done at the Ryder Trauma Center that dictation is a critical component of physician note writing. An ideal note writing application integrates static contents such as laboratory results, structured entry for injury codes and free-form descriptors such as dictation and drawings.
- Order writing capability allows the provider to document the plan of action. There is no order writing capability in BMIS-T.
- Connectivity between reference review and actions in documentation
  o There is an excellent reference review capability in BMIS-T. However, it is no connectivity to actions in documentation. For example, while ordering a specific drug within an application, querying for information should direct the user into the specific drug reference such as Epocrates. That does not exist in BMIS-T.

A significant amount of effort has been spent at Ryder Trauma Center to integrate handheld software technology into the C.A.R.E. system. A number of handheld applications are used daily by all the trauma and critical care physicians to provide complete documentation of trauma and critical care patients. This also includes the generation of descriptive codes for procedures and diagnoses. If the missing in-hospital commission documentation and education applications can be developed, it will be possible to integrate BMIS-T into the C.A.R.E. system.

The strategy at this time is to evaluate the in-hospital documentation component of BMIS-T in a simulated medical environment. The first evaluation is in place at this time. It is an assessment

of the time, motion, accuracy and completeness of injury descriptions generated through the BMIS-T applications.

This evaluation will be compared to a manual entry and another computerized injury description application. A follow on assessment will address the note writing component in a similar human factors approach. This will provide baseline data to determine the impact on performance of clinical functions using the BMIST or any other computerized application. All work requires both University of Miami Institutional Review Board (IRB) as well as Department of Defense (DOD) IRB.

Significant work is in place to structure studies that warrant those approvals. Additionally, the goal is to create a unique laboratory which can develop and evaluate the computerized educational and documentation that are necessary for the future of trauma care.

In summary, the BMIS-T grant started as a very ambitious but unrealistic attempt to try to utilize a computerized documentation tool in a hospital environment as a component of the training of FST's. Over time this grant has become the foundation for developing a software development and evaluation program at Ryder Trauma Center which will provide tremendous understanding of how to optimize the training and care deliver of medical personnel in the battlefield and in civilian arenas.

Key Research Accomplishments

Key research accomplishments for the past year are:
1. Identification of components necessary to develop an integrated documentation system
   a. An injury description module to characterize the evolving understanding of a patient's anatomic and physiological aspects of injury
   b. A note writing application capable of describing the evaluation and plan of care as well as documenting commonly performed procedures
   c. An order writing application to describe the specific elements in the plan of attack addressing the patient's injuries
   d. A reference and reminder component that allows the user to actively review materials
   e. Video lectures covering the spectrum of initial trauma care.
2. Identification of limitations and gaps of BMIS-T system in resuscitation environment
   a. Documentation limitations, such as inability to adequately describe patient
   b. Application medic centered, not able to function in the resusitation/hospital environment
3. Initial stages of development for development of new systems
   a. Note-Writing
   b. Education
4. Usability testing study designs and protocols to identify strengths, weaknesses, functionality and clinician preferences of currently developed systems
   a. Information gathered from these studies will be used in the development and improvement of new applications to ensure that systems being developed meet the needs of targeted users

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5. Initial review of current documentation systems to determine the most pertinent information. To date note documentation systems should include a format easy to input and access the following information:
   a. Mechanism of injury
      i. including specific details
   b. Patients physiologic condition
      i. vital signs
      ii. lab values
      iii. system by system documentation
   c. List of injuries
      i. specific details of the injury
         1. what it is
         2. what has been done
         3. what still needs to be done
   d. Future plan of care
   e. Patient history

Reportable Outcomes

Reportable Outcomes to date are:
1. Identification of trauma clinical environment needs
2. Identification of gaps in BMIS-T application during clinical environment use
3. Identification of trauma educational topics
4. Initial development of educational modules to link into a computer application
5. Identification of trauma protocols needed to be developed
6. Initial development of medical/trauma protocols to be used for point-of-care references
7. Initial stages of computer application development
8. Beginning stages of usability testing between BMIS-T system and injury description system

Conclusions

Both the MCSL/WLIRC have a long history of developing complicated clinical information systems in a busy trauma setting. The C.A.R.E. system developed by the MCSL team under the direction of Jeffrey S. Augenstein, M.D.Ph.D, has provided clinical information support to both the University of Miami, Miller School of Medicine physicians as well as Jackson Memorial Hospital (JMH) clinical and administrative staffs. Jackson is a county hospital, with bed occupancy over 1600. The C.A.R.E. system provides support to well over 1200 of users and has in excess of hundreds of peripherals. Major applications of C.A.R.E. include:
- Operating Room Scheduling
- Physician documentation and coding
- Nurse documentation and coding
- Note writing capabilities
- Laboratory results/viewing
- Physician dictation (Trauma)

Dr. Augenstein has been a leader in the areas of development, research and implementation for trauma informatics for over well over 25 years. Recently technology has begun to catch up with the needs of busy clinicians. Portable devices like Pocket PC's or IPOD's have surfaced as usable tools in the medical arena.   Although these new tools are being used in the medical field to further research, testing still needs to continue in order to meet all the demands required in complex environments.

Our past year of research had identified areas of continued need and improvement in this complex environment.   We anticipate a continued research effort in this area with the BMIS-T team.